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A New Guide for the Arthroscopically Assisted Latarjet Procedure

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Background: The Latarjet procedure is a commonly used treatment for recurrent shoulder instability. However, its neurological complication rate has been reported to be as high as 10%. During the Latarjet procedure, the neurovascular structures are relocated inferiorly and medially. I hypothesized that the risk of nerve injury would be reduced by assisting the inferior-medial relocation of the neurovascular structures intraoperatively.

Methods: Seventeen consecutive patients with shoulder instability accompanied by glenoid bone loss were treated with an all-arthroscopic Latarjet procedure assisted by the novel low-profile SaSumata (SS) guide. The SS guide is inserted through a portal made above the coracoid process and is attached to the coracoid process by 2 pre-fix screws (i.e., temporary pre-fixation screws). Unlike previous techniques, the SS guide is not shuttled from 1 portal to the other to redirect the bone graft from the donor site to the recipient site; instead, it remains attached to the graft throughout the procedure. The SS guide brings the coracoid graft along an inferior-medial trajectory, pushing aside the neurovascular structures with the help of a switching stick. Owing to its semicircular pronged head, the SS guide holds the graft until the pre-fix screws are exchanged with permanent screws. All patients were clinically assessed and underwent computed tomography (CT) scans.

Results: This maneuver was performed arthroscopically in 17 patients, with no conversion to open surgery and no neurological injuries. No patient had recurrence of dislocation after follow-up for a minimum of 24 months. The mean Subjective Shoulder Value was 87.5% ± 11.7%. The mean Rowe score was 88 ± 15.7. The bone block was optimally positioned between 3 o'clock and 5 o'clock and was flush with the glenoid facet in 16 of the 17 patients. There was 1 fracture of the bone block. The mean operation time after the first 5 patients was 125 ± 23 minutes.

Conclusions: The SS guide was a useful tool for performing the arthroscopically assisted Latarjet procedure for recurrent anterior shoulder instability, with good functional results.

Level of Evidence: Therapeutic Level IV. See Instructions for Authors for a complete description of levels of evidence.

The Latarjet procedure (coracoid process transfer) is a commonly used treatment modality for recurrent anterior shoulder instability[1]. It has been recommended as the procedure of choice for correcting shoulder instability when anterior glenoid bone loss is >20%[2,3].

For many surgeons, a substantial barrier to adopting the Latarjet procedure is its wide variety of complications[4,5]. In a series of 34 patients, 20.6% had a transient clinically detectable nerve deficit after the Latarjet procedure and 76.5% had a nerve alert during intraoperative neuromonitoring[6]. Neurological complications have been reported after up to 10% of open Latarjet procedures[7,8].

Due to a trend for minimally invasive surgery, an all-arthroscopic technique has been advocated for Latarjet procedures, but it is technically demanding[9,10]. Not only does the intervention take place close to the brachial plexus, but it also must be performed in the vicinity of the axillary artery. The risk of injuring these structures might make surgeons hesitate to choose the arthroscopic Latarjet procedure.

Disclosure: The author indicated that no external funding was received for any aspect of this work. On the **Disclosure of Potential Conflicts of Interest** form, *which is provided with the online version of the article*, the author checked "yes" to indicate that the author had a patent and/or copyright, planned, pending, or issued, directly relevant to this work (Dr. Imai has a patent pending for the SaSumata [SS]-guide, used to perform an arthroscopic Latarjet procedure) (http://links.lww.com/JBJSOA/A257).

Previous studies have shown that the brachial plexus and the axillary artery undergo an inferior-medial relocation during an open Latarjet procedure[11,12]. These observations led to the hypothesis that the risk of injuring the neurovascular structures would be reduced by assisting this inferior and medial relocation. Over the last 5 years, I have adjusted the arthroscopic instrumentation to make such a maneuver possible, thereby developing the novel SaSumata (SS) guide (Fig. 1-A). Due to its low-profile (1.3-mm-thick), angulated shaft (110°) (Fig. 1-B) and the side-pronged hook ("s-p hook" in Figs. 1-C and 1-D) assisting centering of the guide, it brings the coracoid graft along an inferior and medial trajectory through the subscapularis split.

To my knowledge, the present report is the first to describe an arthroscopic procedure in which the bone-block guide or sutures do not need to be shuttled from the coracoid portal to the anterior portal[10] or to the posterior portal[9] but are guided directly from the coracoid osteotomy site through the subscapularis split to the graft site. The purpose of this study is to report the results and complications of the SS-guide-assisted arthroscopic Latarjet procedure.

Materials and Methods

Patients

Seventeen men were treated with the present technique (mean age, 28 years; age range, 18 to 39 years). All had recurrent anterior instability with >5 dislocation episodes and the first episode having occurred >3 years preoperatively. All patients had a Hills-Sachs lesion with a concomitant glenoid bone defect that was >20% of the original anteromedial diameter.

The study included 4 rugby players, 3 sword fighters, 5 soccer players, and 3 handball players (Table I), none of whom had previous surgery for instability. The remaining 2 patients had recurrent anterior glenohumeral instability after previously failed surgery.

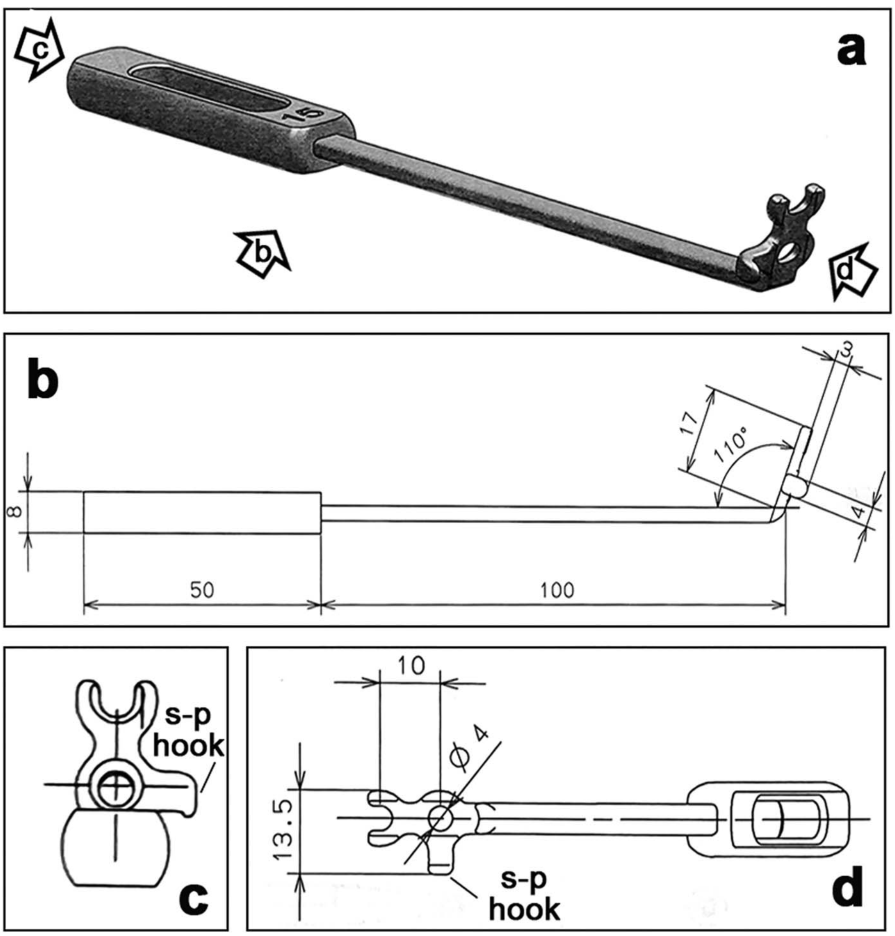

Fig. 1

Schematic drawings of the SaSumata (SS) guide. S-p = side-pronged. **Fig. 1-A** A perspective drawing of the SS guide. Arrows b, c, and d indicate the directions of the corresponding engineering drawings. **Fig. 1-B** A lateral engineering drawing showing that the head of SS guide is angulated 110° in relation to the shaft (as viewed through arrow b of Fig. 1-A). **Fig. 1-C** An engineering drawing as viewed from the bottom of the handle part of the SS guide (as viewed through arrow c of Fig. 1-A). **Fig. 1-D** An engineering drawing perpendicular to the head of the SS guide (as viewed through arrow d of Fig. 1-A).

TABLE I Return to the Sports Activity, According to Preoperative Levels, Following SS-Guide-Assisted Arthroscopic Latarjet Procedure

	University Competitive Team	National Team	High School Team	Recreational Team	Coaching
Rugby player					
Preop. (n = 4)	2		1		1
Postop. return to same level (n = 4)	2		1		1
Sword fighter					
Preop. (n = 3)		1	2		
Postop. return to same level (n = 3)		1	2		
Soccer player					
Preop. (n = 5)	2			3	
Postop. return to same level (n = 3)	1			2	
Postop. return to lower level (n = 2)	1: shifted to a recreational player			1: quit	
Handball player					
Preop. (n = 3)	1			2	
Postop. return to same level (n = 2)	0			2	
Postop. return to lower level (n = 1)	1: shifted to a recreational player				
Total					
Preop. (n = 15)	5	1	3	5	1
Postop. return to same level (n = 12)	3	1	3	4	1
Postop. return to lower level (n = 3)	2: shifted to a recreational player			1: quit	

Procedures

The arthroscopic procedure and handling of the surgical instruments outside the shoulder joint are shown in Videos 1 and 2, respectively.

Instruments are inserted through the anterior portal with posterior viewing (Fig. 2-A). After an anterior capsulectomy is performed, the subscapularis tendon and the anterior glenoid rim are exposed. Then, an arthroscope is transferred to the anterolateral portal ("AL" in Fig. 2-A). The outer surface of the subscapularis tendon, the conjoined tendon, and the pectoralis minor muscle are exposed (Fig. 2-B).

Since the brachial plexus is located behind the pectoralis minor muscle, the pectoralis minor tendon ("Pm" in Fig. 2-C) is detached as close as possible to the coracoid process. This allows visualization of the axillary nerve and the musculocutaneous nerve ("Ax" and "Mc" in Figs. 2-B and 2-C). The entrance of the musculocutaneous nerve into the biceps muscle is also visualized (Fig. 2-C).

Then, the coracoid portal is created (Fig. 2-A). The superior 270° of the coracoid process is decorticated with a burr at its base to prepare for subsequent osteotomy. The SS guide is inserted through the coracoid portal over the superior aspect of the coracoid process (Fig. 2-D). The side-pronged hook ("s-p hook" in Figs. 1-C and 1-D) assists the centering of the guiding Kirschner wire against the width of the coracoid process (Fig. 3-A).

Two cannulated pre-fix (temporary pre-fixation) screws (3.0 mm in diameter and 10.0 mm long) are inserted into the coracoid process (Fig. 3-A), 1 between the semicircular prongs and the other in the proximal screw hole at the head of the SS guide (Figs. 1-C and 1-D). A coracoid process osteotomy is performed 2 to 2.5 cm above the tip of the coracoid (Fig. 3-B). The subscapularis tendon is split horizontally toward its insertion. A switching stick is inserted through the subscapularis split in order to create room for the inferior-medial passage of the coracoid graft by using it as a lever arm (Fig. 3-B). The articular face and graft face of the coracoid process are flattened with an oscillating bone saw (Video 2, 2:26 to 2:31).

The coracobrachialis tendon should never be placed lateral to the switching stick because the switching stick may damage the musculocutaneous or axillary nerve (Fig. 3-C). When the coracobrachialis tendon is placed medial to the switching stick, it acts as a protector of the nerves (Fig. 3-D). Pushing the handle of the SS guide brings the coracoid graft along the inferior trajectory (Fig. 4-A, arrow) through the subscapularis split, pushing aside the neurovascular structure with the help of the switching stick (Video 2, 2:38).

A 1.5-mm Kirschner wire inserted from the pectoralis major portal ("PM" in Fig. 4-B) is directed through the subscapularis split to the screw fixation of the coracoid process at the anterior border of the glenoid. The graft pushes the nerves medially (Fig. 4-C, arrow), and it finally reaches the glenoid neck (Fig. 4-D). The cannulated dilators widen the portal in order to allow the subsequent removal of the pre-fix screws and insertion of the permanent screws ("PM" in Fig. 2-A).

The distal pre-fix screw is removed and exchanged with a 32 to 36-mm-long permanent screw. The proximal pre-fix screw is removed (Fig. 5-A). After a half-turn unscrewing of the distal long screw, the SS guide becomes detachable from the graft owing to its pronged head (Figs. 1-C, 1-D, and 5-B).

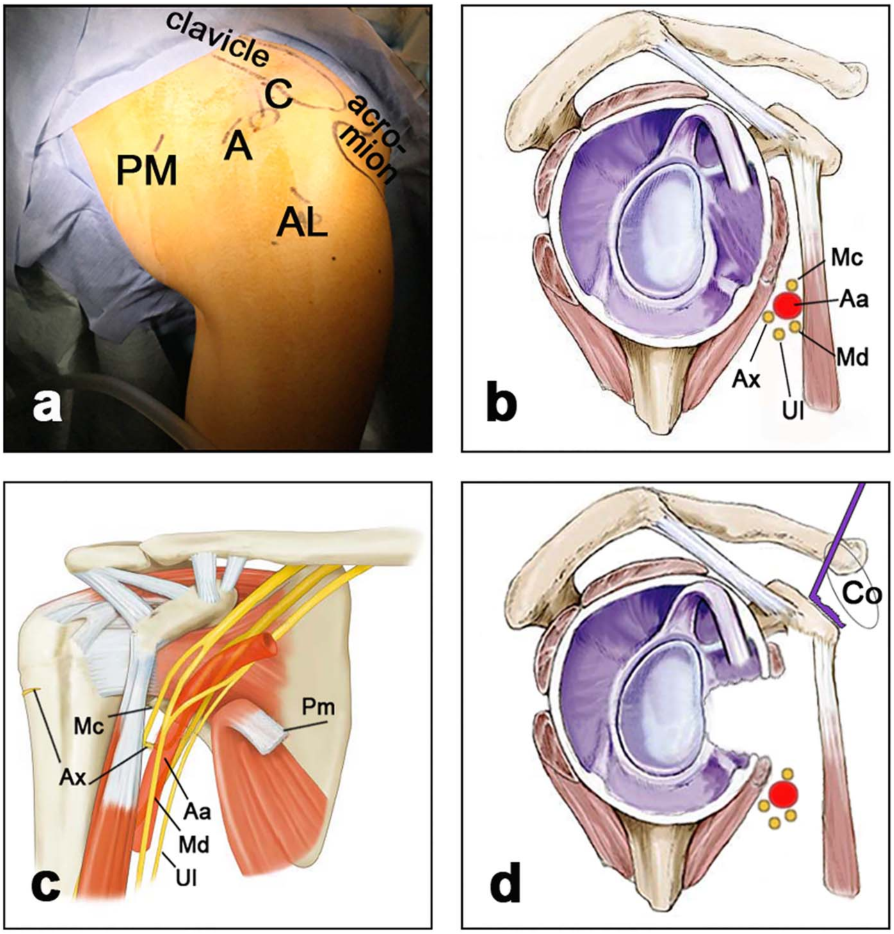

Fig. 2
Demonstration of the anatomical relationships between the portals and neurovascular structures. **Fig. 2-A** Preoperative photograph of the shoulder demonstrating the positions of the portals. A = anterior portal, C = coracoid portal, AL = anterolateral portal, PM = pectoralis major portal. (The conventional posterior portal is not seen). **Fig. 2-B** A schematic drawing showing the neurovascular structures on the glenoid facet level. Aa = axillary artery, Ax = axillary nerve, Mc = musculocutaneous nerve, Md = median nerve, and Ul = ulnar nerve. **Fig. 2-C** A perspective drawing of the neurovascular structures about the shoulder. Aa = axillary artery, Ax = axillary nerve, Mc = musculocutaneous nerve, Md = median nerve, Ul = ulnar nerve, and Pm = pectoralis minor detached form the coracoid process. **Fig. 2-D** A schematic drawing showing the anatomical relationships of the neurovascular structures after an anterior capsulectomy. Co = coracoid process.

Another Kirschner wire is inserted into the proximal screw hole (Fig. 5-C), and a proximal 32 to 36-mm-long screw fixes the graft to the glenoid neck (Fig. 5-D).

Postoperatively, patients wore a shoulder sling for 3 weeks, after which range-of-motion and muscle exercises were started. The patients were advised to return to training-level contact activity 6 months postoperatively and to full contact activity at 9 months postoperatively.

Clinical and Radiographic Evaluations

Clinical evaluations include the Rowe score, Japan Shoulder Society Shoulder Instability Score (JSS-SIS), and the Subjective Shoulder Value. The Rowe score was designed to provide a postoperative assessment of Bankart repairs[13].

Clinical and computed tomography (CT) data were obtained during the follow-up at 2, 6, 12, and 24 months after the surgery. Bone union was considered to have been achieved if there was cortical or trabecular continuity of >1 cm in the oblique sagittal plane at 6, 12, or 24 months. The bone block position was evaluated in the oblique sagittal plane at 2 months to determine if it was between the 3 o'clock and 5 o'clock positions, or too high or too low (by >8 mm). The bone block was evaluated in the axial plane to determine whether it was positioned flush with the glenoid facet, or too far medial or lateral (by >3 mm) to the articulation.

Results

Clinical Results

The present maneuver was performed entirely under arthroscopy in 17 men, with no conversion to open surgery. The mean operation time (and standard deviation) after the first 5 patients was 125 ± 23 minutes. The average follow-up

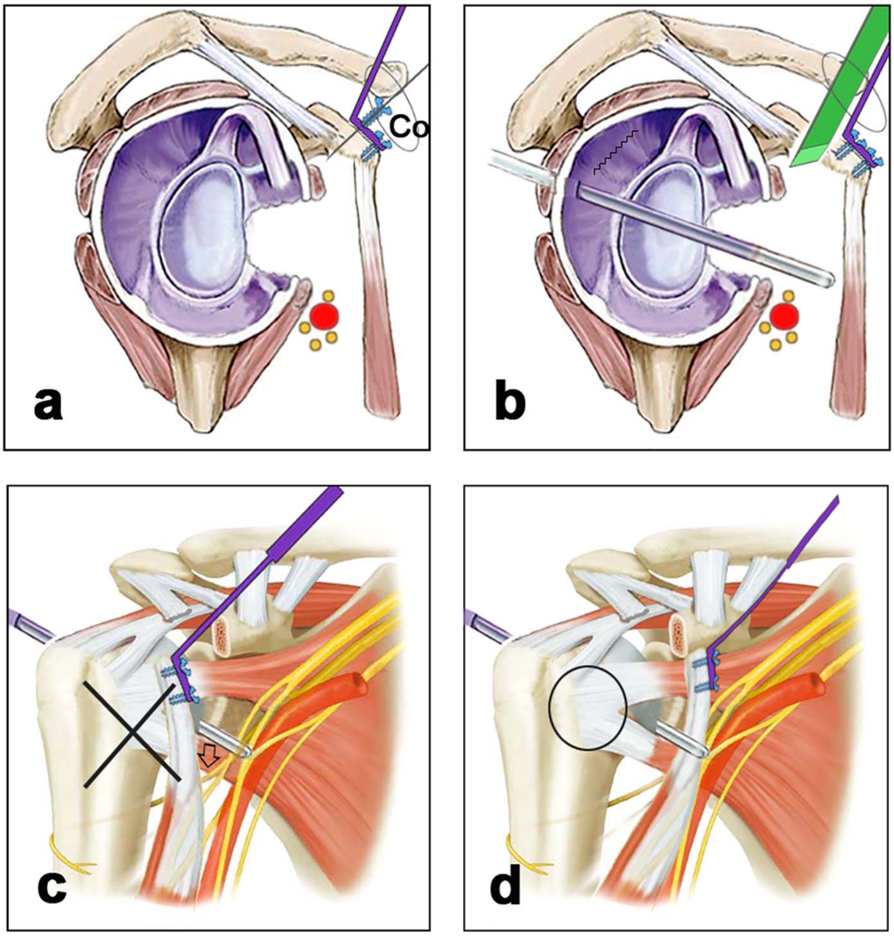

Fig. 3

Schematic demonstration of coracoid osteotomy and preparation. **Fig. 3-A** The head of the SS guide is temporarily fixed with 3.0-mm diameter, 10.0-mm-long screws to the coracoid process through the coracoid portal (Co). With the help of the side-pronged hook, centering of the pre-fix screws is adjusted against the width of the coracoid process (also see Figs. 1-C and 1-D, "s-p hook"). **Fig. 3-B** The osteotome is brought along the shaft of the SS guide, which means that the edge of the osteotomy is angulated 10° toward the tip of the coracoid. **Fig. 3-C** A poor example of the subscapularis split. If the switching stick is used to widen the subscapularis split with the conjoined tendon on the lateral side, it damages the musculocutaneous nerve (arrow). There is a wide variation in the height of the musculocutaneous nerve entering the coracobrachialis. **Fig. 3-D** A desirable example of the subscapularis split using the SS guide. The nerve damage does not take place because the coracobrachialis itself acts as a "protector" against the moving tip of the switching stick.

period was 28 months, ranging from 24 to 32 months, with no patients lost to follow-up. The axillary and musculocutaneous nerves were identified under arthroscopy in all patients. No nerve injuries or infections were observed postoperatively.

Two patients had had recurrent anterior glenohumeral instability after previous failed surgery, and the remaining 15 patients had had no previous surgery for instability. The 4 rugby players, the 3 sword fighters, 3 of the soccer players, and 2 of the handball players returned to their previous level of play, whereas 1 competitive soccer player, 1 recreational soccer player, and 1 competitive handball player decreased their sports activity. Thus, 12 of the 15 patients who had participated in sports preoperatively returned to their previous sports level (Table I).

None of the patients had redislocation or demonstrated apprehension on apprehension testing. The mean JSS-SIS was 92 ± 6.7 (range, 82 to 100). The mean Subjective Shoulder Value was 87.5% ± 11.7% (range, 60% to 100%). The mean Rowe score was 88 ± 15.7 (range, 75 to 100).

The mean postoperative anterior elevation was 175° ± 6.2° (range, 160° to 180°). The mean external rotation with the arm at the side was 78° ± 18° (range, 55° to 85°), whereas it was 82° ± 18.9° (range, 65° to 90°) with the arm in 90° of abduction. On the contralateral side, active anterior elevation averaged 176° ± 4.2° (range, 170° to 180°), external rotation with the arm at the side averaged 84° ± 10° (range, 60° to 90°), and external rotation with the arm in 90° of abduction averaged 89° ± 5.9° (range, 85° to 90°).

Preoperative active anterior elevation on the ipsilateral side averaged 175° ± 3.2° (range, 170° to 180°); the mean external rotation with the arm at the side was 82° ± 9° (range, 65° to 90°), whereas it was 89° ± 5.9° (range, 80° to 90°) with the arm in 90° of abduction. Thus, external rotation tended to

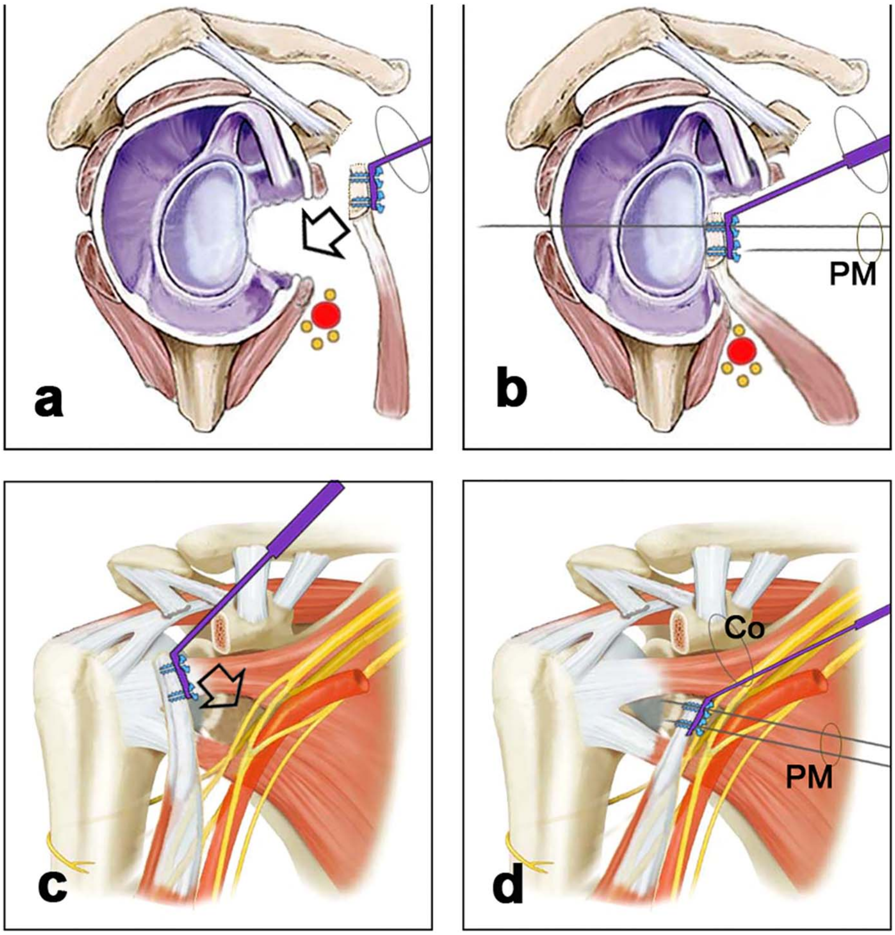

Fig. 4

Schematic demonstration of the inferior-medial trajectory of the coracoid process graft guided by the osteotomy and preparation. **Fig. 4-A** The coracoid process graft is brought along an inferior trajectory from the osteotomy site to the glenoid neck by the SS guide temporarily fixed with 3.0-mm-diameter, 10.0-mm-long cannulated screws. Arrow = inferior trajectory. **Fig. 4-B** A Kirschner wire is inserted through the pectoralis major portal (PM) and finds its way in the exact direction of the screws for fixation of the coracoid process at the anterior border of the glenoid. **Fig. 4-C** The coracoid graft is brought along a medial trajectory from the osteotomy site to the glenoid neck by the SS guide. Arrow = medial trajectory. **Fig. 4-D** Manipulating the handle of the SS guide through the coracoid portal (Co) allows the coracoid graft to set aside the neurovascular structures. The graft is fixed by the guiding 1.5-mm Kirschner wire through the pectoralis major portal (PM).

decrease, but the decrease had no importance, and anterior elevation was less affected by the procedure.

Positioning of the Bone Block

The bone block was optimally positioned between 3 o'clock and 5 o'clock (Fig. 6-A) and was flush with the glenoid surface (Fig. 6-B) in 16 of the 17 patients One bone block was superiorly located—i.e., between 2 o'clock and 4 o'clock—and was also positioned too far medially, whereas no graft was located lateral (by >3 mm) to the articulation.

Bone-Block Healing

Sixteen of the 17 patients had complete bone union (Fig. 6-C). The grafted coracoid did not appear to undergo lysis once it had united (Fig. 6-D). One patient had an early postoperative fracture of the bone block because of unsatisfactory centering of the screw in the coracoid graft. It should be noted that migration and lysis of the fractured bone block did not have any effect on the affected patient's clinical function.

Discussion

The Latarjet procedure has been recommended as the procedure of choice for correcting shoulder instability when anterior glenoid bone loss is >20%, as Bankart repair may not be able to restore anterior shoulder stability in such cases[2,3]. A substantial barrier to adopting the Latarjet procedure is probably its wide variety of complications[4,5].

The present maneuver was performed entirely under arthroscopy in all patients (albeit a limited number in this study), and conversion to open surgery was not needed in any

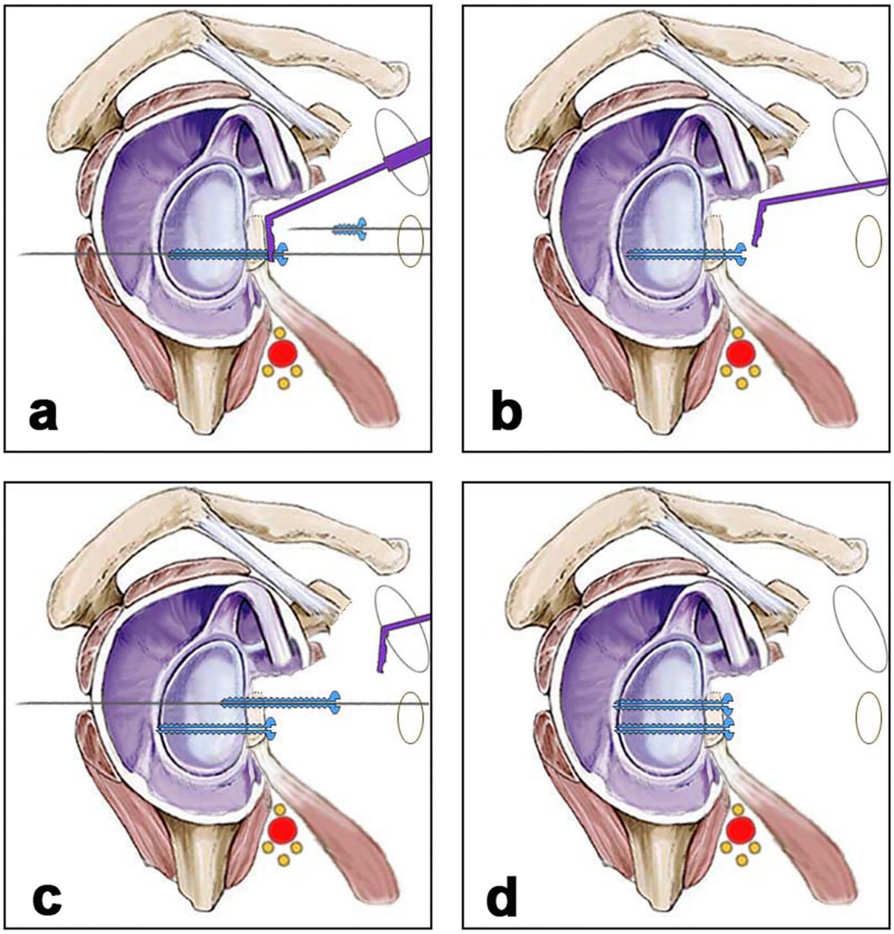

Fig. 5

Schematic demonstration of removal of the SS guide and installation of the permanent screws. **Fig. 5-A** The proximal pre-fix screw and its guiding Kirschner wire are removed after the distal pre-fix screw is exchanged for a 32 to 36-mm-long permanent screw. **Fig. 5-B** A half-turn unscrewing of the distal permanent screw makes the SS guide detachable from the distal screw due to its semicircular pronged head. **Fig. 5-C** A permanent screw, 32 to 36 mm long depending on preoperative scaling, is inserted along another Kirschner wire in the proximal coracoid hole. **Fig. 5-D** Tightening of both long screws rigidly fixes the graft to the glenoid neck.

of them. The rate of return to the same contact-sport level was 12 of 15 (Table I). For comparison, Kee at al. reported that 1 of 29 athletes returned to the same level of contact sports after an open Latarjet procedure, 16 returned to a lower level, 10 changed sports, and 2 quit sports[14]. Although the present results after the arthroscopic Latarjet procedure appear somewhat better, we are aware that the return rates depend on the number of patients and the original sports level.

Many drawbacks of the open Latarjet procedure stem from its narrow surgical field. In a usual setting, the superior half of the subscapularis muscle is incised at its insertion to expose the glenoid neck. In a series of 34 patients treated with the open Latarjet procedure, 7 had a transient clinically detectable nerve deficit after the procedure and 26 had a nerve alert during intraoperative neuromonitoring[6]. In fact, neurological complications have been reported after up to 10% of open Latarjet procedures[7,8].

The arthroscopic Latarjet procedure has a lower risk of nerve lesions (0% to 1.6%[9,11,15-18]) than the open Latarjet procedure (as high as 10%[7,8]). This can be explained by one of the merits of the arthroscopic technique, which is that the nerves are not concealed by retractors. During an open Latarjet procedure, the nerves are retracted, or they may be actually "tethered," while the coracoid graft is removed from the body, trimmed, and prepared for screw fixation. This, in combination with the shortness of the nerve length, is likely how the musculocutaneous nerves sustain traction injury[12,19].

In the present study, the musculocutaneous and axillary nerves were not retracted out of the surgical field but were visualized and pushed down toward the brachial plexus by a switching stick (Figs. 3-C and 3-D; Video 2, 2:38). The nerves are neither tethered by a retractor nor pulled because there is no need to exteriorize the coracoid graft. Trimming of the coracoid graft is completed inside the joint. The SS guide holds the graft so rigidly that it can be trimmed by an oscillating saw in front of the subscapularis split. No patient in the present

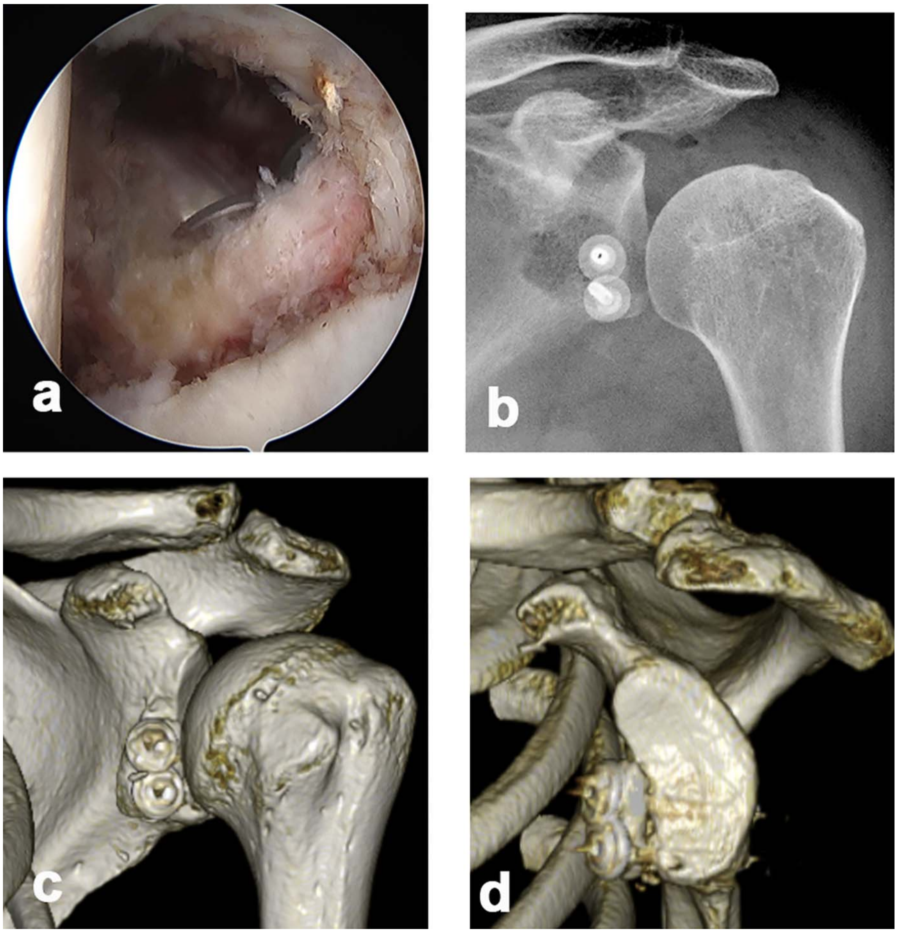

Fig. 6

Postoperative findings after the SS-guide-assisted Latarjet procedure. **Fig. 6-A** Arthroscopic image showing the coracoid graft fixed flush with the glenoid articular surface. **Fig. 6-B** Postoperative radiograph showing an optimal placement of the 2 permanent screws under the equator line of the osseous glenoid. **Fig. 6-C** Three-dimensional computed tomography (3D CT) image showing postoperative fusion of the coracoid graft flush with the glenoid osseous surface. Graft placement was judged to be not flush when the graft was placed too medial or too lateral (>3 mm) to the glenoid bone surface. **Fig. 6-D** A 3D CT image showing a postoperative increase in the glenoid articular surface area, which was brought about by a graft that did not undergo lysis.

study had neurological compromise, although the total number of patients was small.

Boileau et al. reported that 6 patients (13%) required intraoperative conversion from arthroscopic to open surgery in their series of 47 patients[9]. The decision to perform the conversion was due to problems in passing the coracoid graft through the subscapularis split or fixing the coracoid process to the graft site[9]. The need to convert to open surgery indicates technical difficulty with passing the graft through the subscapularis split under arthroscopy. I thought that the passage of the coracoid graft through the subscapularis split would be eased by following an inferior and medial trajectory (Figs. 4-A and 4-C, arrows) rather than a conventional anteroposterior route to the glenoid neck.

Another drawback of the narrow surgical field of the open Latarjet procedure is the risk of malpositioning the coracoid graft, which has been reported in as many as 50% of patients[20-23]. In one series of 48 patients with an open Latarjet procedure, only 41% of the grafts were considered to be optimally positioned[21]. In a study of 85 shoulders treated with an open Bristow-Latarjet procedure, 42 grafts (49%) were malpositioned[24]. Arthroscopy offers the advantage of allowing accurate aiming of the graft on the glenoid neck.

Over the last 5 years, my adjustments to arthroscopic techniques—i.e., developing the SS guide—have made such a precise "aiming" possible. The concept of the SS guide is that placement of a Kirschner wire guides the screw to enter at the 5 o'clock position of the glenoid neck. The 2-pronged head of the SS guide enables the surgeon to aim precisely at the screwing points. It does not cover the head and neck of the 5 o'clock screw. Thus, it allows a surgeon to discern the position and direction of the screw (Fig. 1).

Finally, although less frequent than other complications that have been reported in the literature[10,21,23], the 1 case of bone fragmentation and migration in the present series is a concern. One of the drawbacks of the prototype SS guide is the absence of an apparatus to center the device because I attempted to develop a “simple” guide. The SS guide has a side-pronged hook (“s-p hook” in Figs. 1-C and 1-D) that measures the centering of the guide against the width of the coracoid process.

I am aware that the small number of patients and short follow-up period are limitations of the present study. I think that the follow-up was sufficient to delineate the bone-block nonunion. To my knowledge, the present report is the first to demonstrate an arthroscopic procedure in which the graft guide and sutures do not need to be shuttled from the coracoid portal to the anterior portal[10] or to the posterior portal[9] to redirect the graft but are guided directly from the osteotomy site to the graft site. The SS guide was a useful tool for performing the arthroscopically assisted Latarjet procedure for recurrent shoulder dislocation, with good functional results. ■

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